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TWO ROUTINES TO CONVERT DATA TO UNITS IN DB FOR THE UNIVAC 1230--ETC(U)
AUG 70 C J BECKER, D M POTTER
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NAVAL UNDERWATER SYSTEMS CENTER
NEWPORT, RHODE ISLAND 02840

TWO ROUTINES TO CONVERT DATA TO
UNITS IN DB FOR THE UNIVAC 1230.

by

Clair J. Becker and David M. Potter

NUSC/NL Technical Memorandum No. 2211-88-70

21 August 1970

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INTRODUCTION

During project PARKA, data were received, digitized and processed in real time by the UNIVAC 1230 computer aboard the prime receiving vessel SANDS. The final form of the processed data was displayed as listings and graphs with the values being expressed in db. To convert the data to db, two generalized programs, "TENLOGTEN" and "CONLOGIT" were written to calculate $P = 10 \log_{10} (X)$, where X is a fixed point number within a specified set of limits. The major differences between these two routines are the methods used to obtain the natural logarithm and the scaling necessary for the input values.

ADMINISTRATIVE INFORMATION

This memorandum was prepared under NUSC Project Title: Long-Range Acoustic Transmission Experiments for Surveillance Systems Development; R. Hasse and R. Martin, NUSC/NL Principal Investigators. The sponsoring activity was ONR, Code 102-OS; Dr. J. B. Hersey, Program Manager.

"TENLOGTEN"

Routine "TENLOGTEN" calculates $10 \log_{10} X$ by evaluating a 5th degree polynomial. Expressing $10 \log_{10} X$ as

* This routine was written for NUSL by TRACOR under contract for project PARKA.

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$$b_5 = (10 \log_{10} e) a_5 = .13966237.$$

Routine "TENLOGTEN" calculates N and evaluates the above equation. A flow chart of "TENLOGTEN" is shown in Figure 1.

Program Usage

To call on routine "TENLOGTEN", enter the value X in the A register, scaled 22 bits, and RJP*TENLOGTEN. The answer appears in the Q register scaled 3 bits.

If the inputted number X is less than or equal to zero, the routine returns a value of 4000000000₈.

"CONLOGIT"

"CONLOGIT" also calculates $P = 10 \log_{10}(X)$, by obtaining the natural logarithm using a subroutine called "NATLOG"* and converting to P by equation (3). To use "NATLOG", the number X must be expressed in the form $X = N \cdot 2^S$, where $1 \leq N \leq 3777777_8$. "CONLOGIT", assuming the scale factor, S is 15, checks N to see that it is within limits. If it is not, "CONLOGIT" shifts N down so that the most significant bit is in the proper position and then adjusts S accordingly.

"NATLOG" uses a method attributed to Dr. H. Maehly** to calculate the natural logarithm. Rewriting X as

$$X = 2^m F, \quad (5)$$

where m is an integer and $1 \leq F \leq 2$,

$$\ln(X) = (m + \frac{1}{2}) \ln 2 + P_0 + \sum_{k=1}^3 \frac{-P_k}{F + T_k}, \quad (6)$$

where the vertical bars imply 'continued fractions,' that is

$$\sum_{k=1}^3 \frac{-P_k}{F + T_k} = \frac{-P_1}{F + T_1} \cfrac{-P_2}{F + T_2} \cfrac{-P_3}{F + T_3}, \quad (7)$$

* NATLOG was supplied to NUSC by UNIVAX as part of the software package delivered with the 1230 computer.

** H. Maehly, Monthly Report, Institute for Advanced Study, Princeton, Oct 1956.

and $P_0 = 3.681656603$,
 $P_1 = 34.41069291$,
 $P_2 = 8.126503834$,
 $P_3 = 0.2665195666$,
 $T_1 = 10.37967214$,
 $T_2 = 2.051212813$, and
 $T_3 = 0.4249952497$.

Figure 2 is a flow diagram of "CONLOGIT" and Figure 3 is the flow chart of "NATLOG".

Program Usage

To use "CONLOGIT", the number X is put in the Q register, scaled to 15 bits. If X is negative, "CONLOGIT" sets it positive and proceeds, or if X is zero, an answer of -50.0 is given. If an error exit occurs in "NATLOG" caused by the scale factor S being outside of the limits, an answer of -100.0 is given. The answer, $10 \log_{10}(X)$ will be in the Q register scaled 3 bits.

To call on "CONLOGIT", use the call "CONLOGIT" or use "RJP*CONLO

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APPENDIX A

LISTING OF "TENLOGTEN"

TENLOGTEN	ENTRY	INPUT IN A SCALED 22D
	ENT*B7*LOGCOUNT	N GOES TO W(LOGCOUNT) ON NORM INSTRUCTION
	ENT*Q*O*APOS	PREPARE Q FOR NORMALIZATION
	JP*LOGERR	NEGATIVE INPUT
	JP*LOGERR*AZERO	INPUT WAS 0
	NORM*AQ*W(B7)	1 . GE . X . LT . 2
	SUB*A*2000000000	MINUS 1
	STR*A*W (LOGARG)	
	ENT*B7*3	
LOGLOOP	ENT*Q*W(LOGCONT4)	B4
	MUL*W(LOGARG)	EVALUATE POLYNOMIAL
	ADD*A*W(LOGCONTB7)	ADD COEFFICIENTS
	STR*A*Q	SCALING IS 27,25,23,21 AS
	BJP*B7*LOGLOOP	B7 IS 3,2,1,0
	MUL*W(LOGARG)	
	STRVA*W(LOGARG)	POLYNOMIAL
	ENT*Q*W(LOGCOUNT)	N
	SUB*Q*6	N-6
	MUL*W(LOGCONT5)	(N-6)(-3.0102)
	ADD*Q*W(LOGARG)*QPOS	PLUS POLYNOMIAL
	SUB*Q*100000*SKIP	ROUND OFF
	ADD*Q*100000	
	RSH*Q*16D*SKIP	SCALE TO 3 PLACES
LOGERR	ENT*Q*4000000000	ERROR VALUE
	EXIT	OUTPUT IN Q SCALED 3
LOGCON	DATA*4 . 3407541D,21D	
	DATA*-2 . 1363335D,23D	
	DATA*1 . 2571730D,25D	
	DATA*-.59091302D,27D	
	DATA*.13966237D,29D	
	DATA*-3 . 0102D,19D	
LOGARG	0	
LOGCOUNT	0	

APPENDIX B

LISTING OF "CONLOGIT"

	PROCEDURE* CONLOGIT	
	STR*Q*A*APOS	IS NUMBER NEGATIVE
	CP*Q	YES, COMPLEMENT
	JP*CL4*AZERO	IF ZERO, JUMP TO CL4
	STR*B7*L(CL7)	SAVE B7
	ENT*B7*1	INITIALIZE COUNTER
CL2	LSH*Q*1	CHECK FOR POSSIBLE SCALE DOWN
	JP*CL3*QNEG	SCALE DOWN REQUIRED, JUMP TO CL3
	BSK*B7*13D	ALL OVERFLOW VALUES CHECKED?
	JP*CL2	NO
	JP*CL5	NUMBER WITHIN RANGE
CL3	ENT*B7*B7-13D	SET SCALE FACTOR
	STR*B7*CPL(167)	MAKE POSITIVE
CL5	ENT*Q*X(B7-15D)	SET NEW SCALE FACTOR
	CP*Q	MAKE POSITIVE
	RSH*A*B7	RESET INPUT VALUE IN A
CL1	RJP*NATLOG	COMPUTE NATURAL LOG
	JP*CL6	ERROR EXIT FROM NATLOG
	RSH*AQ*30D	NAT LOG IN Q SC=24D BITS
	MUL*33626754	CONVERT TO COM LOG SC=18D
	RSH*AQ*36D	COM LOG IN Q SC=12D BITS
	MUL*12	CONVERT TO 10 log (db)
	ADD*Q*400*APOS	ROUND OFF POSITIVE NUMBER
	SUB*Q*4000	ROUND OFF NEGATIVE NUMBER
	RSH*Q*9D*SKIP	SC=3 BITS
CL6	ENT*Q*X76337	ERROR, SET ANS TO -100.0db
CL7	ENT*B7*0	RESTORE B7
	RETURN	EXIT
CL4	ENT*Q*X77157	-50.0 IF NUMBER=0
	JP*L(CONLOGIT)	EXIT
	END-PROC*CONLOGIT	

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APPENDIX C

LISTING OF "NATLOG"

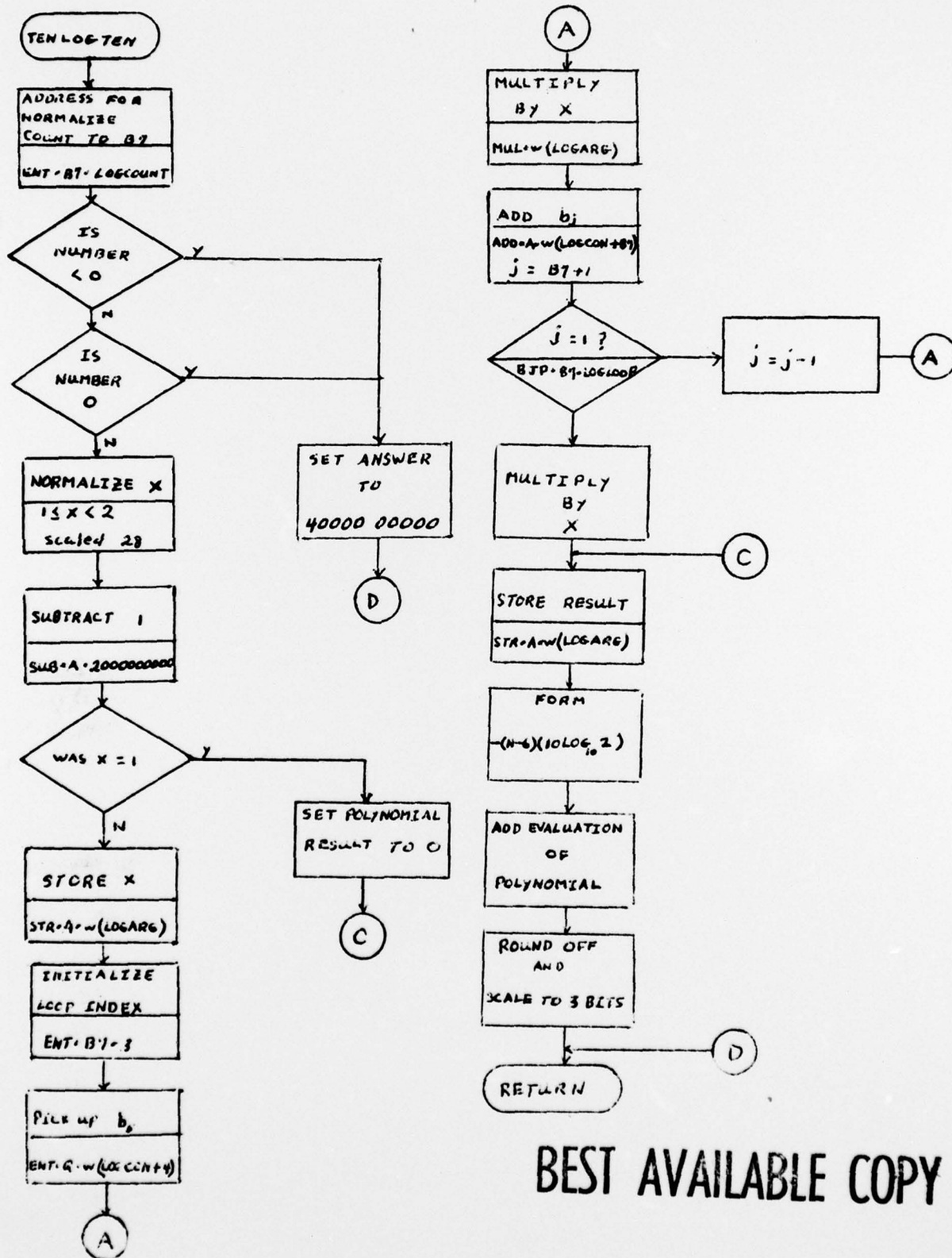
NATLOG	JP*0	ENTRANCE
	STR*Q*CPW(KITTY)	COMPLEMENT, SAVE SCALE FACTOR
	CL*Q	CLEAR REGISTER
	ENT*A*A*APOS	IS NUMBER POSITIVE
	CP*A	NO, COMPLEMENT
	RPT*29D	
	LSH*A*1*ANEG	AND COUNT SHIFT
	JP*NAT2	NUMBER IS ZERO
	STR*B7*L(NAT1)	SAVE COUNT
	LSH*A*W(KITTY+2)	
NATI	ENT*Q*X(0)	
	ADD*Q*W(KITTY)	ORIGINAL INPUT
	LSH*Q*3	M SC 3 IN Q
	ADD*Q*4	$M+\frac{1}{2}$ SC=3
	CL*A	
	MUL*W(POOL)	$(M+\frac{1}{2})LN2$ SC=3+29D
	RSH*AQ*9D	RIGHT TO SC-23D
	ENT*A*A*AZERO	
	CP*A*ANOT	IS A 0 or all 7's
	RPL*Y+1*L(NATLOG)*SKIP	YES
	JP*L(NATLOG)	ERROR EXIT
	STR*Q*W(KITTY+1)	
	ENT*Q*W(KITTY+2)	F
	ENT*Y+Q*W(POOL3)	F+T3 SC=23D
	ENT*Y+Q*W(POOL3)	F+T3 SC=23D
	STR*A*W(KITTY+3)	
	ENT*Y+Q*W(POOL2)	F+T2 SC=23D
	STR*A*W(KITTY+4)	
	ENT*Y+Q*W(POOL1)	F+T1 SC=23D
	STR*A*W(KITTY+5)	
	ENT*Q*W(POOL3+1)	-P3 SC=23D
	ENT*A*X77777	SET SIGN
	LSH*AQ*23D	ADJUST SC TO 46D
	DIV*W(KITTY+3)	
	RPL*7+Q*W(KITTY+4)	SAVE FOR NEXT CONTINUED FRACTION
	ENT*Q*W(POOL2+1)	-P2 SC=23D
	ENT*A*X77777	SET SIGN
	LSH*AQ*23D	ADJUST SC TO 46D
	DIV*W(KITTY+4)	
	RPL*Y+Q*W(KITTY+5)	SAVE FOR NEXT CONTINUED FRACTION
	ENT*Q*W(POOL1+1)	-P1 SC=23D
	ENT*A*X77777	SET SIGN
	LSH*AQ*23D	ADJUST SC TO 46D
	DIV*W(KITTY+5)	
	ADD*Q*W(KITTY+1)	
	ENT*Y+Q*W(POOL+1)	ANSWER
	LSH*A*1	SCALE ANSWER TO 24D BITS

APPENDIX C (cont)

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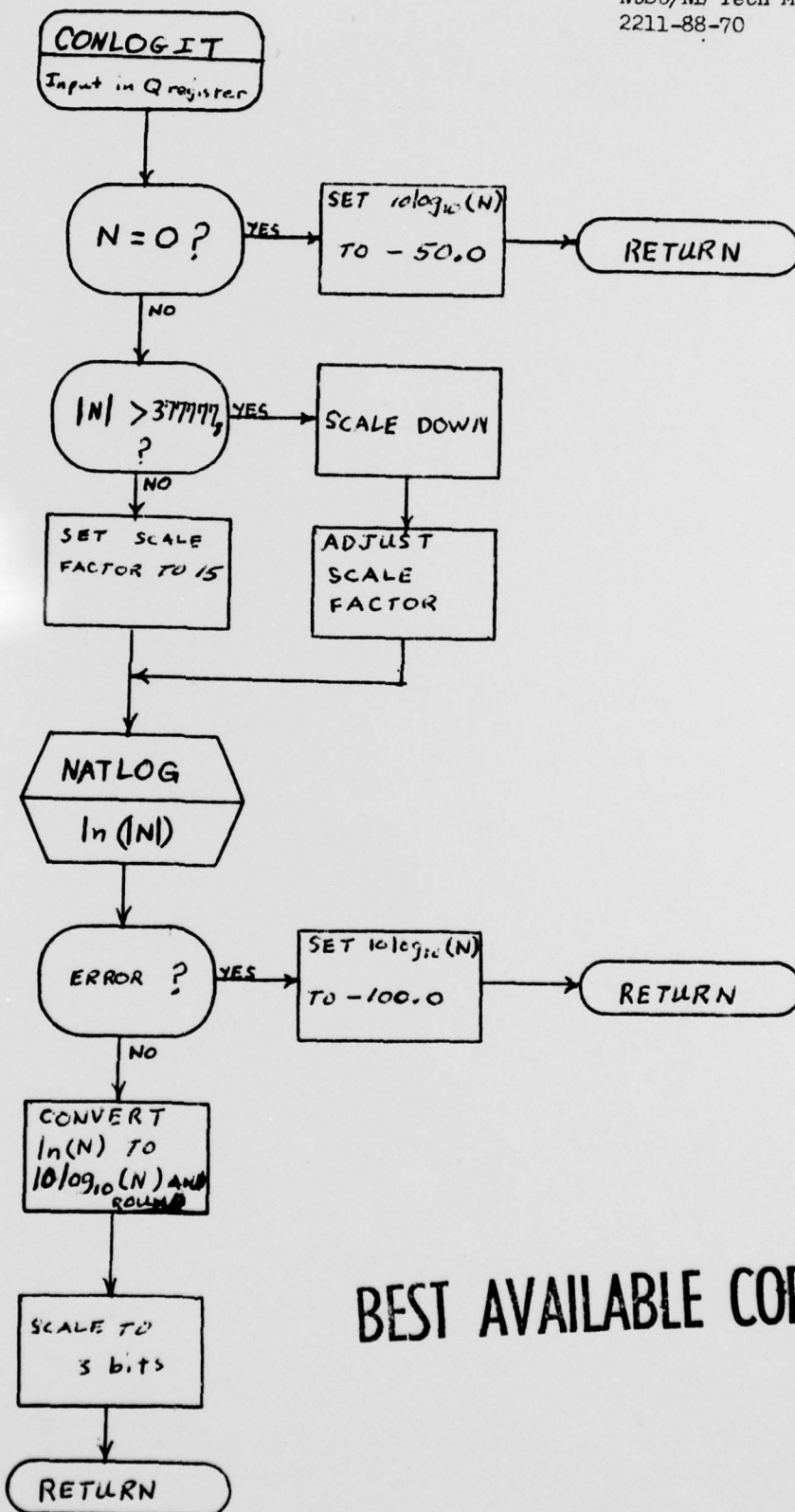
	JP*L(NATLOG)	NORMAL EXIT
POOL	2613441377	LN(2) SC=29D
	0165640206	PO SC=23D
POOL3	0015463077	T3 SC=23D
	7767361257	-P3 SC=23D
POOL2	0101507044	T2 SC=23D
	7373747270	-P2 SC=23D
POOL1	0514114431	T1 SC=23D
	5662667151	-P1 SC=23D
KITTY	RESERVE 6	

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Fig. 1 - Flow Chart of "TENLOGTEN"



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Fig. 2 - FLOW DIAGRAM OF CONLOGIT

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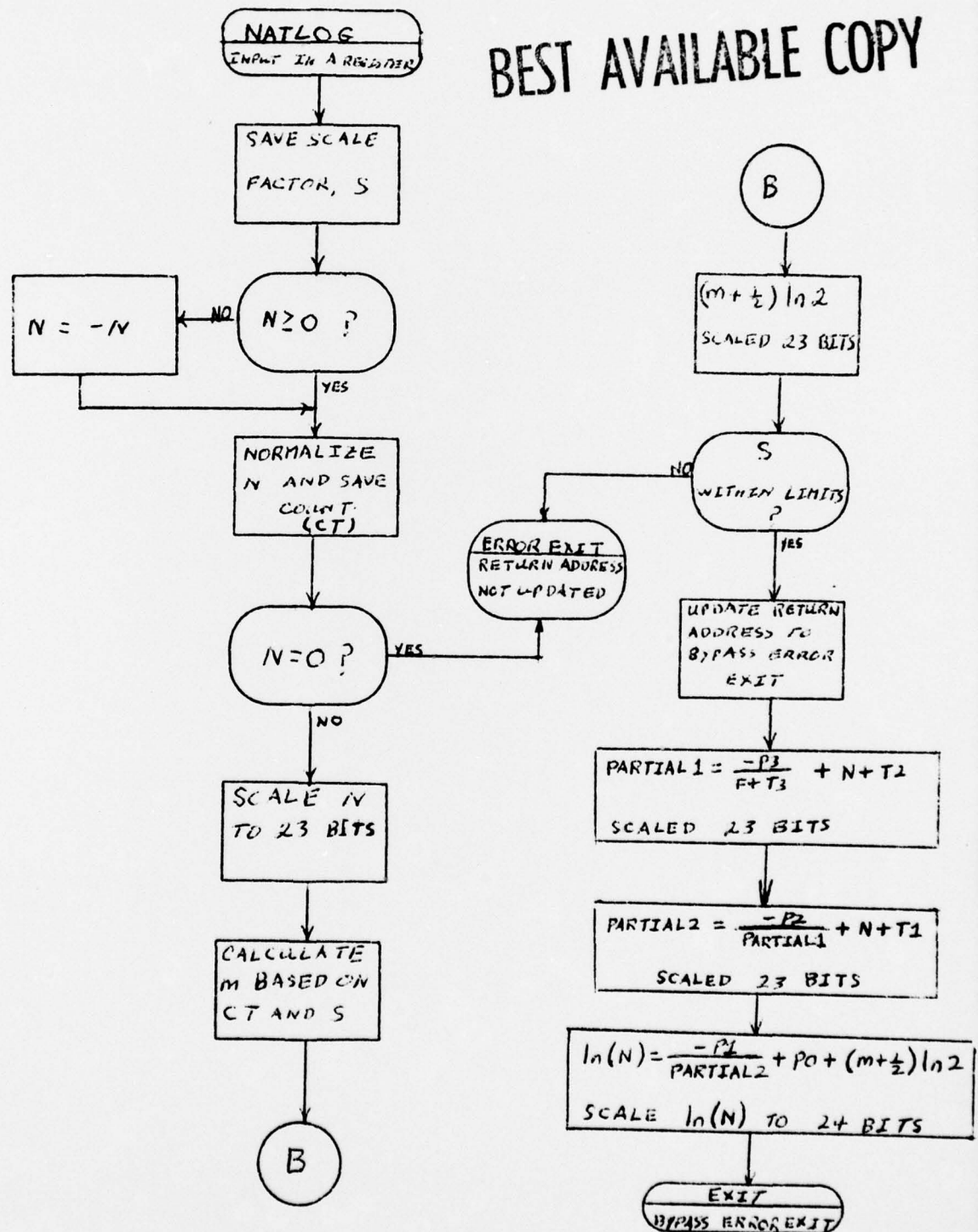


Fig. 3 - FLOW DIAGRAM OF NATLOG